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Studies of Cyprinodont Fishes. XXI. *Glaridodon latidens*, from Northwestern Mexico, Redescribed and Referred to *Poeciliopsis*¹

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(Plate I; Text-figure 1)

INTRODUCTION

AMONG the most troublesome jobs faced by the systematist is the proper allocation of old species based solely on insufficient and imperfect type material from an unknown or indefinite locality. One such species, *Glaridodon latidens* Garman, from "Chihuahua, Mexico," has posed an enigma since no specimens fitting the description have heretofore been brought to light from northern Mexico. The generic placement of this fish has always remained in doubt.

On the basis of a critical comparison of the four female type specimens with the extensive series of *Poeciliopsis* in the University of Michigan Museum of Zoology (UMMZ), we identify *Glaridodon latidens* with confidence as a valid species of the genus *Poeciliopsis*. It is assumed that the type locality of *P. latidens* is not in the Rio Grande drainage, as has commonly been supposed, but is probably in the headwaters of the Rio del Fuerte. This Pacific-drainage stream rises in Chihuahua, although the material we interpret as *latidens* is entirely from the adjacent states of Sonora and Sinaloa, through which this

stream and others inhabited by the species also flow. It is one of the common poeciliids in the Pacific drainage of northwestern Mexico.

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STATUS OF GLARIDODON LATIDENS

Types.—The existing type material (MCZ No. 1307) consists of four adult females, about 22

¹ Contributions from the Scripps Institution of Oceanography, New Series, No. 681, and from the Museum of Zoology, University of Michigan.

to 25 mm in standard length. The specimens are stained brown, somewhat shrivelled, and the fins are mostly broken. One individual has half of the lower jaw pulled off and another has both jaws pulled off, presumably by Garman when he examined the dentition (see Garman, 1895, Pl. V, Fig. 11). There is a small hole through the side of each specimen, and one has been dissected on the left side to expose the vertebrae.

Type Locality.—In response to a query regarding the type locality, Mrs. Dick wrote on December 5, 1952, as follows:

The specimens of *G. latidens* were catalogued by F. W. Putnam in April, 1861, as being from Chihuahua, Mexico, and the preceding entry, 1306, also was recorded from there, with a reference to an original number of 1 for 1307 and 1-3 for 1306. These must be original numbers in a small collection for they are not numbers used by Agassiz, the Smithsonian or any other source that I can run down. I can't find any previous record of any fishes from Chihuahua in Putnam's records or catalogues. Evidently these fish were specimens he found here since they are not on any of the lists of specimens received previous to 1861. There is no record of the collector or of the date of collection.

In his account of this species, listed as *Glari-dichthys latidens*, Meek (1904, p. 134) wrote:

I do not know this species, and I am inclined to think there is some mistake in the locality given for it. I do not believe this genus is represented in northern Mexico.

The genus *Poeciliopsis* is almost wholly restricted in its distribution to the Pacific drainage, where it ranges from Arizona to Colombia, although it is replaced by related genera in Panama and the adjacent part of Costa Rica. On the Atlantic slope it is not known north of the basin of the Rio Chachalacas, in Veracruz, Mexico (Plan del Rio; material at the University of Michigan), although the area between Veracruz and Chihuahua has been well explored ichthyologically. It is therefore natural that the designated locality of Chihuahua for *latidens* has been open to doubt. However, study of the drainage relationships shows that a considerable area in eastern and southeastern Chihuahua drains into the Pacific, chiefly through Rio Yaqui and Rio del Fuerte, but in small part also through Rio Sinaloa and Rio Culiacan. Since Meek (1904, p. xxxviii) collected in the head-water portion of the Yaqui and reported only *Poeciliopsis occidentalis* for that region, and since extensive collections made by Ralph G. Miller and John T. Greenbank and party in the middle and lower parts of the same river contain no species comparable to *P. latidens*, it is concluded that the types of that species were not collected in the Rio Yaqui system. If correctly referred to Chihuahua, they probably came from

the upper part of the Rio del Fuerte although no collections are at hand from this section of the river. Lower in the same stream, in both Sonora and Sinaloa, a species we identify as *Poeciliopsis latidens* is common. This species also occurs in the Sinaloa and Culiacan systems, but it seems improbable that the types were taken in either, for the areas they drain in Chihuahua are small, sparse in population, relatively inaccessible and very probably too high and mountainous for this type of fish.

POECILIOPSIS LATIDENS (Garman)

Glaridodon latidens.—Garman, 1895, p. 42, Pl. V, Fig. 11, teeth (original description; Chihuahua, Mexico).

Glari-dichthys latidens.—Meek, 1904, p. 134 (account taken from Garman; type locality questioned). Regan, 1906-08, p. 99 (account taken from Garman). Regan, 1913, p. 1002 (species listed without description).

Poeciliopsis latidens.—Hubbs, 1926, pp. 66-67 (comment on type locality; referred to *Poeciliopsis* on basis of description only). Jordan, Evermann & Clark, 1930, p. 189 (listed only). De Buen, 1947, p. 279 (provisionally listed; range given, obviously by presumption, as "Cuenca del río Bravo, en río Conchos (Chihuahua)"). Alvarez, 1950, p. 88, footnote (status not clear; unidentifiable from original description).

A critical study of the four types of this species demonstrates clearly that it is referable to the Poeciliidae, even though the type series includes no males. Each of the four females shows characteristics that separate the Poeciliidae from the other cyprinodont families. The first three rays of the anal fin are unbranched, the third ray reaches nearly to the tip of the fin, and the fourth ray is widely branched. The neuromasts or pit organs are arranged along the axial scale row posteriorly and, on the caudal peduncle, along the second row above the midventral row. The two series of scales with pit organs are separated, as in most poeciliids, by one row of unpored scales. Anteriorly, some neuromasts occur on scales in the next row above the axial series and in irregular locations above the anal fin and thence forward to below and behind the pectoral fin. The second scale row above the axial series may also have a few neuromasts near the dorsal fin (this is not a family character).

Although fully reliable generic identifications in the Poeciliidae can be made only from males, the general resemblance of the types of *Glaridodon latidens* to species of *Poeciliopsis* led the senior author to refer *latidens* correctly to that

genus. This generic reference, however, would remain in doubt were it not for the remarkably close correspondence between the types of *latidens* and a *Poeciliopsis* that is common in northwestern Mexico (from near Alamos, Sonora, southward to Mazatlan, Sinaloa).² *P. latidens* is a banded or spotted species with the outer row of firm teeth arranged in a broad arc. Of the species heretofore referred to this genus, only *P. fasciata* (Meek), from the Pacific drainage of southern Mexico, fits this type, but the correspondence is not as close with *fasciata* as it is with the similar species in northwestern Mexico that we identify as *latidens*. The two forms are closely related but appear to be specifically distinct.

Description of the Four Types.—Fin rays: dorsal 7 and anal 9 in all (since Garman counted the two elements of the last ray separately, he reported 8 and 10 rays, respectively, for these fins); pectorals 12 or 13; pelvics 5 or 6; caudal 13 or 14 (11 or 12 branched) in 3, the counts questionable since the outer rays are broken. Scales in lateral series (from shoulder girdle to caudal base) 30. Vertebrae (including urostyle) $13 + 19 = 32$ in all (as determined by X-ray photography and further verified on the specimen dissected by Garman). Gillrakers (including all rudiments) on first arch 13 in 3 and 14 in one. Mandibular pores 2–2 in all; preopercular pores 7–7 in 2, the number indefinite in the remainder due to irregularities in the closing of the canal; pores on preorbital represented by an open groove; no pores on top of head, but there is a pair of more or less developed longitudinal grooves on the interorbital and a nearly transverse postorbital canal which may be open or roofed over, with a pore at either end.

The dentition, of major importance in the classification of the species of *Poeciliopsis*, is essentially as described and figured by Garman. The outer teeth are moderately long, and are hooked backward and semi-erect throughout. The outer edge of each tooth is moderately expanded toward the tip, the inner edge broadly expanded and more or less angulate, sometimes approaching a secondary cusp. As a result each tooth has a rather asymmetrical leaf shape. The outer teeth are rather firmly implanted, especially as compared with the loosely attached teeth of such species as *P. turubarensis* (Meek) and *P. presidionis* (Jordan & Culver). These teeth form a rather strongly curved and very even series, without a median indentation. They are comparatively large and few (about 20 to

24 in lower jaw). The inner teeth form an irregular series that lies close to and parallels the outer row. The inner row forms an even arc that extends farther backward in each jaw than the outer row, in an almost longitudinal continuation of the sweeping curve. The inner teeth slightly approach the outer ones in individual form.

There are about 8 or 9 narrow, dark, transverse bars, counting a rather indefinite small one at the base of the caudal fin and a trace of another at the shoulder. The better-developed bars are somewhat higher than the length of the eye. The next to the last is about as well developed below as above the midline of the side or is even better developed below, but proceeding forward the bars are more dorsal and some of those on the trunk reach well toward and sometimes to the mid-dorsal line. There is a fine dotted axial streak that disappears near the head, a fine pencilled black streak between the anal and caudal fins, and a weak, deep-lying, irregular row of dots between the caudal and dorsal fins and before the dorsal, disappearing anteriorly. Near the back the surfaces of the scale pockets become rather thickly and evenly peppered with black dots and are bordered by broad crescents, but downward on the sides the crescents become narrower and less regular. Some melanophores extend downward to the anal fin, but the lower part of the peduncle (except for the streak) and most of the abdomen are largely devoid of melanin. Melanophores very weakly line the dorsal, caudal and anal rays. There are rows of scattered dots along the pectoral rays but apparently none along the pelvic rays. No definite spots or bars are evident on any of the fins, which were described by Garman only as "clouded with brownish." The whole top of the head is pigmented, with some intensification on the snout, especially in a large blotch before each nostril. The upper lip is dark. The chin, including the intergular region, is punctulate; the preorbital largely so. A narrow band of pigment also borders the orbit posteriorly but fades out ventrally. The cheek has almost no pigment. The opercles are silvery, with very little black pigment except for a definite concentration on the upper anterior part.

The axis of the body is almost straight and the dorsal and ventral contours are about equally curved anteriorly (suggesting a midwater habitat). The origin of the dorsal fin lies a little in advance of or approximately over the end of the anal base, and before the base of the caudal a distance measuring 1.7 to 1.75 times in the predorsal length (stepped measurements are used throughout). The origin of the anal fin lies

² Since this paper was put in type, specimens have been received that extend the range of *P. latidens* 35 miles farther south.

midway between the caudal base and the upper end of the preopercle. The distance from the tip of the snout to the insertion of the pelvic fin is contained 2.0 to 2.5 times in the standard length. The body cavity does not extend into the urosome.

The greatest body depth is contained 4.3 to 4.7 times in the standard length. The depth is maintained through the caudal peduncle, the least depth of which enters the head 1.6 to 1.9 times (the long preservation and poor condition of the specimens has probably resulted, however, in a deepening of the peduncle). The length of the head enters the standard length 3.7 to 3.9 times. When stepped into the head length, the depth of the head measures 1.3 to 1.4; the width, 1.5 to 1.6; the interorbital width, 2.3 to 2.4; the distance between the orbits ventrally, 2.6 to 2.8; the length of the snout, 3.6 to 4.8; the diameter of the eye, 3.6 to 4.4; and the greatest overall width of the mouth, approximately 3.0.

In top view the mouth is moderately curved. The midline length of the upper lip is about one-fourth or one-fifth its greatest width. In side view the gape is moderately developed; the length in projection is about equal to the diameter of the pupil. The main part of the gape forms an angle of about 20° with the horizontal throughout about two-thirds of its length and then becomes nearly vertical. The length of the upper jaw enters the head length 3.3 to 3.4 times. In side view the angle of the head is 33° to 39°; that of the muzzle 89° to 90°; in front view, lines across the orbit meet below at 15° to 19°.

The depressed length of the rounded dorsal fin is contained 3.7 to 4.0 times in the predorsal length. The anal fin is also rounded and its length enters the distance from its origin to the caudal base 2.2 to 2.4 times. The length of the pectoral enters the head length 1.5 to 1.6 times. The short pelvic reaches to about the middle of the anus and its length is contained about 2.6 to 3.0 times in the head length. The pelvics are separated by a space nearly twice the width of the base of either fin.

DIAGNOSTIC CHARACTERS OF POECILIOPSIS LATIDENS (OTHER THAN THOSE OF GONOPODIUM)

A small, banded and/or spotted species of *Poeciliopsis* with the outer teeth few, asymmetrical, rather long and firm, hooked backward, and semi-erect throughout, arranged in a broad and evenly curved arc, without median indentation. Each outer tooth has a rather asymmetrical leaf shape (Garman, 1895, Pl. V, Fig. 11). The inner teeth are irregularly arranged, usually in one series, in an even arc that

parallels the outer row of teeth, but is continued farther back, almost longitudinally, in each jaw. In form the inner teeth slightly approach the outer ones. There are about 7 to 12 narrow, dark transverse bars and spots in adult females, most commonly 8 or 9 (all faint spots or bars were included in the count). Typically at least one, and usually several, of the bars reach or nearly reach the mid-dorsal line. The bars and spots are variable in shape and irregular in spacing, both individually and bilaterally. Typically, few bars extend much, if any, below the middle of the sides. In the adult males, the spots and bars are usually fewer than in the females, but are often more intense; they vary from about 6 to 10, typically 7 or 8. About 1 to 3 bars extend to or close to the mid-dorsal line. As in the females, few bars extend below the middle of the sides and their development and spacing is variable and asymmetrical. There is a definite though not pronounced dark streak on the anterior dorsal ray and first inter-radial membrane in each sex. In the immature fish the bars and spots are usually less numerous and the bars often extend below the midsides. The preorbital is naked. The pores of the lateral-line system on the head are arranged as follows: mandibular pores well developed, 2–2; preopercular pores variable, 5 to 7, typically 7–7; and preorbital pores varying from an open groove (0–0) to 3–3. The body axis is almost straight and the dorsal and ventral contours are about equally curved anteriorly.

GONOPODIUM OF POECILIOPSIS LATIDENS

Value of Gonopodial Characters.—The pertinence of *Glaridodon latidens* to the genus *Poeciliopsis* is attested by the remarkably constant finer structure of the marvellously complex gonopodium (the anal fin of the male modified as an intromittent organ). Very minor differences come to light when the organ of *P. latidens* is compared in detail with that of *P. presidionis* (the type species) and other species referred to the genus, but many trenchant distinctions become apparent when the gonopodium of *P. latidens* is contrasted with that of the species classed in any other genus of the subfamily Poeciliopsinae (Hubbs, 1924, pp. 9-10; 1926, pp. 62-64; 1936, pp. 232-235). These conclusions would have been evident on the basis of the gonopodial characters described in 1936 and are definitely strengthened and extended by a survey of the male genitalial characters of the Poeciliopsinae recently made by the senior author. There is scarcely a part of the gonopodium that does not exhibit fundamental resemblances within the genus *Poeciliopsis*, and striking differences between the related genera.

In this as in other groups of the Poeciliidae, the gonopodial characters are of vastly greater taxonomic significance, above the species rank, than all other known morphological features combined. For these reasons, the description of the gonopodium needs to be long and detailed, merely to define characters by which other species and genera differ.

Methods of Study.—The gonopodial features are difficult to determine, because the rays are crowded and folded together, are in places bilaterally asymmetrical to a surprising and on first study confusing degree, and are highly modified, especially in the minute segments near the tips of rays 3 to 5. With repeated study and practice, however, the structures can be made out under appropriate lighting and magnification, particularly when the fin is manipulated with two fine needles. It is helpful, especially on early study, to tease (or chemically dissolve) the individual rays apart, or at least to unfold the fin or to pry the overlapping rays aside as the organ is turned, so that individual rays may then be followed. Toward the tip, where the segments become inordinately small, the manipulation entails great but, with care and patience, not insuperable difficulty. After the detailed structure is learned, the extreme constancy of the various parts can be perceived by gross examination and probing, without continued splitting apart of the rays. Earlier descriptions of the poeciliopsine gonopodia, such as those of Hubbs (1926), were crude and in some respects inaccurate, as was later pointed out (Hubbs, 1936).

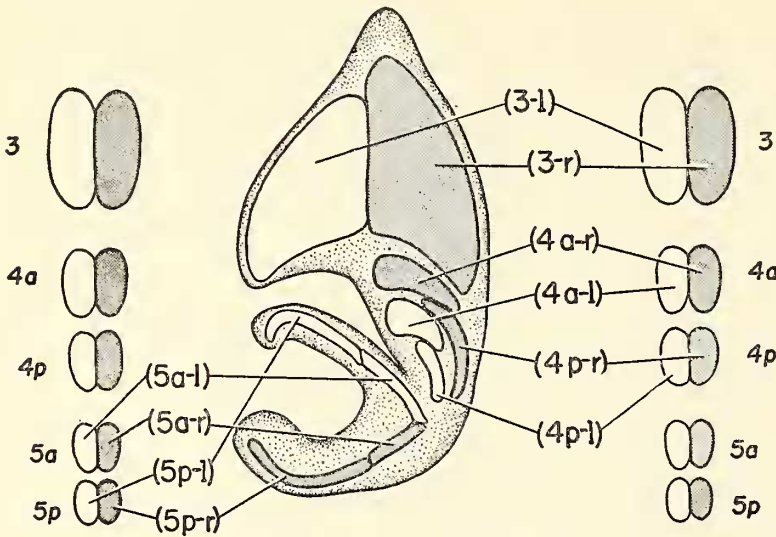
Terminology.—In matters of orientation and terminology of parts we do not follow all the innovations made by Gordon & Rosen (1951) and Rosen & Gordon (1953). The gonopodium as a whole and its constituent rays are described as though held vertically downward from the base, as is customarily done in describing anal fins. Thus the front or anterior edge of the whole gonopodium or of any ray, in our terminology, is the morphological front part, not the lower or ventral part as usually described by Gordon & Rosen, who viewed the gonopodium as it is held at rest, extending almost straight backward. Similarly, we speak of the direction toward the tip of the fin as downward, not backward. The terminology of parts we follow agrees with the conventional illustration of the gonopodia in vertical position and avoids inconsistencies and awkward expressions. Similarly, we follow the primitive morphological orientation of rays that become rotated 90° or 180° in the elaboration of the gonopodium. In details, we retain the term *trough* rather than *canoe-like form* for the concave posterior edge of ray 5; *crescentic horn*

for a structure curving over the extreme tips of the rays; and *membranous hood* for the dermal keel around the tip of the gonopodium. And we do not carry over from the nonhomologous condition in *Xiphophorus* the distinction between proximal and distal serrae (on ray 4p). We find it convenient to distinguish formally between the left and the right halves of given rays or branches of rays, for the two halves are often structurally different; thus, 3-l means the left side or segments of ray 3, and 4p-r means the right side or segments of the posterior branch of ray 4. Since the modification of the anal fin involves almost all its parts, the entire fin, beginning with rudimentary rays 1 and 2, is treated as the gonopodium. The last ray, as we consistently define it for the soft dorsal and anal fins, comprises the last two elements that are structurally distinct, including their structural bases, whether these elements be approximated or widely separated.

Description of Gonopodium.—The following description is based on the 57 males with completely or almost completely elaborated gonopodia in a large collection (UMMZ No. 164642) from Rio Yecorato, tributary of Rio Sinaloa, about 7 miles north of Guasave, Sinaloa, Mexico; collected by R. G. Miller on May 6, 1942.

The gonopodium is a very long and slender structure, inserted far forward (preanal length 43 to 48, averaging 46, percent of the standard length, in 30 specimens) but extending to within about an eye's length of the procurrent caudal rays. In the same specimens the overall length is 42 to 47 (average 45) percent of the standard length. The gonopodium is relatively thick (weakly compressed); near the middle of its length its left-right width is more than half the anteroposterior length.

The main rays (3 to 5) of the gonopodium are profoundly modified in size, shape, relative position and symmetry, as is indicated in part by the somewhat diagrammatic sketch (Text-fig. 1) representing the approximate appearance of a cross-section toward the middle of the length of the longest rays. The right side is weakly convex, the left side deeply concave, and ray 5 is rotated clockwise so that the tips of 3-l and 5p-l are almost in contact. As in all of the hundreds of specimens of *Poeciliopsis* examined, the tube is consistently on the left side. All 57 males in the series studied and 7 additional more or less completely transformed specimens have a sinistral gonopodium. This finding confirms the views of Hubbs (1936: 232-235) and of Hubbs & Hubbs (1945: 290-293), that the laterality of the gonopodium is consistently characteristic of the genus in all Poeciliopsinae (other than *Xenophallus*). The recent re-exam-



TEXT-FIG. 1. Semidia-grammatic cross-section of the gonopodium of *Poeciliopsis latidens*, toward the middle of the length of the longest rays, with the rays and their branches and bilateral halves identified and homologized with the corresponding parts of a more primitive gonopodium (diagrammed at either side).

ination of the gonopodia in the various genera of the family reveals no other exception to this rule.

The asymmetry of the organ is consistent also in the position of the first two rays and of the posterior rays (behind 5), as is described below, and involves the detailed flexure of the main rod (composed of rays 3, 4 and 5). As viewed toward its anterior edge this rod, consistently, is gently curved longitudinally toward its right side, with the strongest point of flexure about opposite the tip of ray 6. Beyond this point the gonopodium curves very gently toward the left side of the fish, outward to the moderately thickened and opaque area, about five-sixths of the way out, beyond which the terminal region, rapidly narrowing and becoming glassy, swings back toward or to the midline. The extreme tip is hooked almost at a right angle forward and slightly to the left.

When the undissected gonopodium is viewed from the right side, beyond the little distorted base and before the highly modified tip, there are visible: (a), the strongly curved right side of ray 3 (3-r), occupying about half the side; (b), the part of 4a-r that is not overlapped by the produced edge of 3-r; (c), almost all of 4p-r; then, (d), curving away, 5a-r, and, (e), when the troughlike ray 5 is rotated counterclockwise away from its normally infolded position, also 5p-r, curving away toward the left. When the gonopodium is viewed from the left, there are seen only: (a), the extreme front of 3-r; (b), the whole rounded left side of 3-l (narrower and with a less trenchant rim than the right side of 3-r); and (c), the morphologically right (but now actually left) side of 5p-l and 5a-l, plus (d), the sloping left side of 5a-r

and, (e), the very edge of 5p-r; also (f), some of the left side of 5p-r, when the trough is rotated counterclockwise. When in normal position 5-l, rotated nearly 180°, fits against or close to the left edges of 4a-r, 4a-l, and 4p-l; and 5-r is rotated nearly 90°, in the same direction.

The gonopodium is heavily charged with black pigment along the right side of ray 3. The posterior part of this ray is clear, except very near the base and except on the outer third of the fin, out to the unpigmented vitreous tip. There is also a heavy suffusion of pigment along the trough of ray 5 and there are scattered dots on the right side of the main part of the gonopodium and along the short posterior rays.

Rays 1 and 2 are more minute than in most related forms. They are consistently deflected somewhat toward the left side and lie in a shallow trough between the basal forks of 3. Ray 2 overlaps at most one segment of 3 beyond the unsegmented base.

Each rather compressed fork in the hidden base of ray 3 is broadly expanded at the extreme end, beyond which the fork is at first slender and then is dilated anteroposteriorly toward the union of the forks; the expansion continues toward the basal segments. The unsegmented base is long. The ray is only moderately expanded, less so than in most related forms, along the first few segments beyond the unsegmented base. These expanded segments are only about twice as broad as long. The basal sutures of 3-r run transversely near the posterior edge, but are deflected slightly downward toward the front edge. The first few segments of 3-l are separated by V-shaped incisions on the posterior margin. The longitudinal suture between 3-l and 3-r runs distinctly to the left side of the anterior

crest of 3, farther to the left than in some other species of the genus. Throughout the length of ray 3 the sutures remain essentially transverse. Before the middle of the length of the ray, the segments change from broader than long to about square (as seen at right angles to the surface of the ray). Near the outer limit of the slight distal thickening, ray 3 narrows and in cross-section changes from a broad triangle to a relatively thin, weakly curved, transverse structure greatly narrowed in lateral view but only moderately constricted in anterior view. Beginning with a point where this transformation in form has become nearly completed, and extending outward for a distance about twice the length of one of the median segments of the ray, several segments are almost completely fused to form the *consolidated segments* characteristic of the genus. This structure is relatively soft. Beyond the consolidated segments, the sutures again become sharp and a few of the segments become subserrate on the right margin. These outer segments are somewhat wider than long but are not strikingly dilated (as they are in some species). Each segment-half (the two halves flare apart in one plane) is longer than wide. The extreme distalmost segments become greatly reduced, most notably in width. Somewhat longer than broad, they extend to the extreme hooked tip, on the inside of the curve.

Near the base ray 4 is moderately thickened, more so on the anterior than on the posterior edge. The basal segments in side view are less than one-half broader than long. The left and right halves are in full and approximately symmetrical contact. At the very base ray 4 lies just behind 3, the two abutting without overlap, but soon 4 becomes displaced toward the right, so as to lie against 3-r and to be overlapped in part by the trenchant posterior edge of 3-r. Not far beyond the tip of 6, the ray branches to form 4a, which takes over the thickened portion and becomes rotated far toward the left, and 4p, which is somewhat broader in side view than 4a. Ray 4a becomes more nearly transverse than longitudinal, whereas 4p remains chiefly longitudinal. As a result the whole ray is very strongly curved. Its total anteroposterior width is much less than the width of the left side of 3. All parts of 4 are comparatively robust. In cross-section each half of 4p is a thin plate, gently concave on the left side and convex on the right. The left segments of each branch come to lie partly behind their right partners (as is particularly evident when the rays are manipulated with a needle), because the thickened anterior (now essentially left) edge of 4a-l lies behind 4a-r. In side view, both branches of 4-l are narrower than those of 4-r.

The posterior (now largely right) edges of 4a-l and 4a-r somewhat overlap 4p-l and 4p-r, respectively. The segments of 4, like those of 3, remain essentially transverse. Out toward the modified tip, the segments of 4p become nearly twice as long as broad; those of 4a, at least twice as long as broad. In this region the segments of 4a are about as long as those of 3 and about one-fourth longer than those of 4p.

Opposite the consolidated segments of ray 3, ray 4a flattens out transversely so as to lie close against and directly behind the similarly flat and transverse part of 3, and its segments are similarly though less completely consolidated. As the consolidated segments are approached, 4a-l becomes rather narrow, less robust, and very much softer than 4a-r, which is here the principal element. Toward the extreme tip, the segments of 4a-r, separating 3 and 4a-l and remaining transverse, become somewhat dilated but remain less than twice as wide as long. Continually diminishing in size, the segments of 4a extend to the extreme tip, hooking around the curved tip of 3. In the terminal region of the gonopodium, 3 and 4a are so closely apposed and are so similar (and are so different from and so well separated from 4p) as to give the false impression that they are the anterior and posterior branches of the same ray.

In the thickened subterminal section of the gonopodium, the segments of ray 4p become transformed into serrae. Including two or three segments of transitional form, the serrae number about 17 on each side (left and right), and cover about one-fifth the total length of the gonopodium. All but the most basal serrae of 4p-r are like rose thorns, each arising from a base about twice as long as broad. Each thorn is directed essentially backward, with some angulation toward the left. The serrae of 4p-l, in contrast, are directed toward the left. The several distalmost serrae of 4p-l form thorns that are wider and more compressed than the opposite elements of 4p-r. The other serrae of 4p-l are strikingly unlike the thorns of 4p-r, being flat and more or less two-horned, or merely truncated. In this outstandingly peculiar bilateral asymmetry of the serrae of 4p, *Poeciliopsis latidens* agrees with other species of its genus but differs from those of related genera. The serrae extend to about opposite the end of the consolidated segments of 3 and 4a. The more basal and the more distal serrae of the two sides are readily separated by a fine needle, and those of each branch are very loosely articulated, but the more median ones are more firmly connected (bilaterally and longitudinally). Toward the tip, ray 4p swings onto the left side of the gonopodium. Beyond the serrae the segments become

extremely minute but seem to continue onto at least the base of the abruptly curved extreme tip of the organ. Such features are seen only under high magnification, with the gonopodial tip turned at the most propitious angle.

At its extreme, essentially symmetrical base, ray 5 is considerably strengthened, though much slenderer than it is farther out. Very near the base, the ray rotates toward the left so that only the anterior edge lies on the right side. Before the end of ray 6, the left edge has already become trenchant and turned clockwise nearly 180°. Here is seen the start of the trough that characterizes the species of *Poeciliopsis* and some of the related genera. This trough is formed by the flaring apart, to somewhat less than 90°, of the halves (5-l and 5-r) of the ray. In this trough, as already noted, 5-l normally lies against 4, with its tip close to the posterior edge of 3-l. Throughout most of the length of the gonopodium 5a-l and 5a-r remain connected only at their anterior edges, while 5p-l and 5p-r are widely separated. Consequently, the trough is floored by the two halves of 5a as well as 5p. The whole trough is capable of considerable rotation: it can be moved clockwise to nearly close the gonopodial tube, or counterclockwise, tending to restore the primitive linear sequence of the rays. Near the middle of the gonopodium and for some distance toward the base, the sides of the trough diverge at nearly a right angle, but both basad and apicad the halves approach one another to decrease the angle. Throughout most of the length of the ray the segments of both 5a and 5p are greatly compressed platelets. The relative shapes of these segments differ at different levels and on the two sides. Just beyond the tip of 6, the left side is much more expanded than the right. The posterior rim of 5p-r rather abruptly swings toward the left and somewhat forward, and the right side rapidly regains a width approximating that of the left. The proportionate width of the segments of the two branches is dissimilar, however, for 5a-l as seen from the trough is little wider than 5p, whereas 5p-r is about twice as wide as 5a-r. In cross-section 5a-r is scarcely curved. Near the middle of the gonopodium the segments of ray 5, considerably shorter than those of 3 or 4, differ in dimensions in the two branches and on the two sides: those of 5a average about one-fourth longer than those of 5p; those of 5a-l are about twice as long as broad, whereas those of 5a-r are about 2.5 times as long as broad; those of 5p-l average about one-half longer than broad, whereas those of 5p-r are approximately square. Throughout their lengths, from the extreme base to the tip, the sutures of both sides and of both branches remain essentially transverse, and the

two free edges form a rather even line, unmodified in the direction of serrae, lobes, or other processes. Each edge, more particularly the left, is hooked inward.

The outer segments of ray 5 are considerably modified. Opposite the most basal serrae of 4p, the squarish segments of 5a-l have become about three times as broad as the more rodlike and strongly curved elements of 5p-l, and the segments of 5a-r are also broader than those of 5p-r. Beyond the middle of the gonopodium the stiff free edge of 5-l remains trenchant and approximated to the left posterior edge of 3, whereas 5-r becomes narrower and softer. Opposite the basal serrae ray 5-r becomes membranous and seems to disappear, so that at the tip of the gonopodium only 5-l is recognizable. Here 5-l forms a thin keel along the side of 4, just in advance of 4p-l, which is similarly turned toward the left. Opposite the base of the consolidated segments (and opposite the place where the bicornute serrae of 4p-l change into flat thorns), the posterior edge of 5-l remains nearly straight while the anterior edge is sharply contracted, so as to decrease the width of 5-l abruptly and greatly. Opposite the distalmost serrae 5-l becomes an extremely fine and delicate double strand closely connected with the almost similarly reduced tip of 4p. Both tips run along the edge of a slightly expanded membrane that narrows down to the left edge of 4a, near the base of the apical hook. In some specimens, on close scrutiny, the now excessively attenuated strands may be followed, together, along the edge of the hook.

All segments in the tip of the gonopodium are relatively soft. The extreme tip is minutely hooked, forward and somewhat to the left, nearly to a right angle. Along the outer edge of the hook the apex bears a thin, evenly rounded membranous hood about one-third as wide as long (the length measured along the morphologically posterior but here transverse apex). The weak to obsolete crescentic horn runs in the base of the membranous hood along the outer curve of the terminal segments of 3 and 4, which reach to the extreme tip.

The four posterior rays of the gonopodium are extremely short. Of these only ray 6 is thickened. It is in a thick opaque fleshy mass that is deflected consistently onto the left side of 5. The swollen tip of 6 is rounded along the front edge, both transversely and longitudinally. It is somewhat more convex on its left than on its right side. The segments become fused in the outer two-thirds of the swollen area.

Rays 7 and 8 are also distinctively modified, but in a very different and peculiar way. Both remain very slender throughout, not developing

swollen tips such as are characteristic of certain other genera of Poeciliopsinae (7 may be very slightly strengthened near its tip). Each is only incipiently branched at the tip. These rays originate apart, in normal file, but instead of remaining well separated throughout, as they do in the young males and in females of all ages, and as they do in the males of most poeciliids, they abruptly converge to become very closely approximated or in actual contact along the middle section of their lengths. Here ray 7 consistently lies more or less to the left of 8, giving rise to the false impression that these rays are the slightly dislocated left and right halves of a single ray. Distally the rays diverge rather widely. This peculiar condition of 7 and 8 is a consistent character of *P. latidens* and of the other species of *Poeciliopsis*. It holds for all 57 developed males in the series studied, with one abnormal exception. In this aberrant specimen, ray 6 is minute and clavate and is concealed in the inter-radial membrane just in advance of the base of 7. The latter ray has taken over the form of 6, presumably because the developmental field that normally affects 6 acted on 7, which in this specimen follows 5. In this aberrant gonopodium, 8 is less slender than usual and is well separated from 7 and from 9.

The fore and aft elements of ray 9 are greatly reduced. In some specimens they are discernible with difficulty, even under high magnification and good illumination, but are probably never completely atrophied. They lie close together well behind 7 and 8, often in a more or less thickened and irregular little mass or lobe.

A small scaleless area surrounds the posterior end of the gonopodial base, but there is no naked groove behind the fin.

The multitudinous gonopodial characters described above are all definitive—of the subfamily, genus, or species. These observations confirm the opinion that no structure-complex in fishes is known to be more replete with characters than is the gonopodium.

COMPARISON BETWEEN GONOPODIA OF *P. LATIDENS* AND *P. PRESIDIONIS*

When the gonopodium of *Poeciliopsis latidens*, as described above, is compared in detail with that of topotypes of *Poecilia presidionis* Jordan & Culver, the type species of *Poeciliopsis*, a most remarkable agreement in fundamental structure is seen to prevail, from the first ray to the last and from the base of the fin to the highly modified tip. Many minor differences, however, appear, and are validated by studying series of specimens. These distinctions are mostly of degree and illustrate the range of differentiation to be found between well-defined

species of the genus, all within the limits of a single highly distinctive general pattern.

Insertion of Gonopodium (measured from extreme base).—*P. latidens*: farther forward, preanal length 2.1 to 2.33 in standard length. *P. presidionis*: preanal length 2.0 to 2.1.

Length of Gonopodium (from origin at extreme base to farthest tip).—*P. latidens*: averaging longer, 2.1 to 2.4 in standard length. *P. presidionis*: 2.3 to 2.5.

General Dimensions of Gonopodium (near middle).—*P. latidens*: relatively thicker (left-right width more than half anteroposterior dimension). *P. presidionis*: more compressed (width less than half anteroposterior length).

First Few Segments of 3-r (beyond unsegmented base).—*P. latidens*: less expanded, about twice as broad as long, with sutures only slightly decurved forward and downward; without longitudinal depression. *P. presidionis*: more expanded, about thrice as broad as long, with sutures strongly oblique (forward and downward); depressed longitudinally to receive overlap of 4.

Longitudinal Suture between 3-1 and 3-r.—*P. latidens*: displaced a little farther toward midline. *P. presidionis*: nearer front ridge.

Width of Ray 3 near Middle of Fin.—*P. latidens*: about half width of gonopodium at same level. *P. presidionis*: much less than half width of gonopodium.

Consolidated Segment of 3.—*P. latidens*: very soft, narrower, with both contours grading evenly into those of following rays. *P. presidionis*: stiff, broader, with keeled margin at left side abruptly constricted just before end (but right edge grading evenly into edge of following segments).

Segments of 3 beyond Consolidated Segment.—*P. latidens*: each segment-half (the two halves flaring apart in one plane) longer than wide; a few subserrate on the right margin. *P. presidionis*: each segment-half about as wide as long, rather irregular in form but not distinctly subserrate on right margin.

Basal Part of 4 (opposite middle part of 6).—*P. latidens*: scarcely dilated; segments nearly square, less than 1.5 times broader than long; abutting 3-r. *P. presidionis*: markedly dilated; segments about twice as broad as long; overlapping 3-r.

Ray 4 near Middle of Length.—*P. latidens*: 4a more nearly transverse than longitudinal; ray much more curved; its total anteroposterior width much less than width of left side of 3; all parts more robust; 4-1 normally lying largely behind 4-r. *P. presidionis*: 4a more nearly longitudinal than transverse; ray much straighter; its total width about equal to width of left side

of 3; all parts more compressed and fragile; 4-1 normally lying beside 4-r.

Broadest Subterminal Segment of 4a (about midway between consolidated segment and tip of ray).—*P. latidens*: definitely less than twice as broad as long. *P. presidionis*: twice or somewhat more than twice as broad as long.

Trough of 5, Basal to and near Middle of Gonopodium.—*P. latidens*: less flaring, the sides forming an angle of less than 90°. *P. presidionis*: usually flaring more than 90°.

Relative Widths of Segments of 5 (relative lengths in cross-section, as in Text-fig. 1).—*P. latidens*: 5a-l little wider than 5p-l as seen from trough; 5a-r about one-half width of 5p-r. *P. presidionis*: 5a-l about twice width of 5p-l; 5a-r and 5p-r subequal.

Curvature of 5a-r (in cross-section).—*P. latidens*: scarcely curved. *P. presidionis*: strongly curved.

Several Segments of 5a-l Basal from Consolidated Segment of 3.—*P. latidens*: With morphologically anterior edge (now posterior and flexed to the left) forming a straight line. *P. presidionis*: each segment with anterior (now posterior) edge produced toward left into a firm rounded lobe.

All Ray Tips.—*P. latidens*: very soft. *P. presidionis*: stiffer.

Extreme Flexed Tip of Gonopodium (twisted forward and to left).—*P. latidens*: curved nearly to right angle or hooked beyond a right angle. *P. presidionis*: not curved to a right angle.

Tips of Rays 3 and 4a in Flexed Tip of Gonopodium.—*P. latidens*: extending to extreme tip; inner edge of apical flexure not appearing keeled. *P. presidionis*: ending abruptly in terminal membrane well in advance of tip, usually not far beyond middle of final flexure, so that the hood seems to extend around tip onto inner side of curve.

Crescentic Horn (in flexed tip of gonopodium).—*P. latidens*: weak to obsolete, not extending to tips of rays 3 and 4a. *P. presidionis*: usually strong and conspicuous, occasionally rather weak; extending in a weak hook well beyond tips of rays 3 and 4a.

COMPARISON WITH POECILIOPSIS FASCIATA

Poeciliopsis latidens is most closely related to *P. fasciata* (Meek), from which it differs primarily in coloration and in markings (Table I). The principal difference lies in the number and shape of the vertical bars, which show sexual dimorphism in each species. Mature males of *fasciata* typically have only 3 to 5 narrow, vertical bars, and the females usually have 4 to 5; the total variation is from 2 to 6. Mature males of *latidens* usually have 7 to 10 broader bars

and spots (or spots only), and the females generally have 8 to 12 such markings; the total range is from 5 to 14.

There is considerable variation in the markings of *P. latidens*. For example, in a sample from the Rio Quelite, Sinaloa (UMMZ No. 160576), vertical bars are almost absent and there are fewer spots than usual, 5 to 9, usually 6 to 8, in females, 7 each in two males, and 5 only in one male. In a collection from the Rio Piaxtla (about 45 miles north of Mazatlan), the vertical bars are narrow as in *fasciata*, but there is no dark streak at the front of the dorsal fin and the bars are more numerous than they are in that species. The markings of *latidens* do not appear to be constant within a single stream system, but all samples examined (25) can be readily distinguished from *fasciata* on the basis of one or more of the characters listed in Table I, and on other less obvious but constant differences, chiefly of pigmentation.

There appears to be a broad gap in the ranges of the two species. *P. latidens* is not known south of Mazatlan³ and *P. fasciata* has not been recorded north of the Isthmus of Tehuantepec. The known range of *latidens* is believed to represent the actual range reliably because the region south of Mazatlan has been visited by fish collectors and no species of *Poeciliopsis* corresponding to *latidens* has been obtained. On the other hand, the area immediately to the west of the basin of the Rio Tehuantepec (where *fasciata* lives) is little known and we have seen no collections between western Oaxaca and Acapulco, Guerrero. In the brackish lagoon about 10 miles north of that city (Laguna Coyuca, UMMZ No. 164689) there is a species of *Poeciliopsis* that is representative of (and perhaps identical with) *fasciata*; the same species also has been taken in Arroyo Nuxco, Guerrero (UMMZ No. 159896), about 60 miles northwest of Acapulco. It may eventually be found that *latidens* and *fasciata* are connected by a chain of intermediates in the area between Guerrero and Sinaloa. If so, the two forms, with, perhaps, some additional subspecies, may be referred to a single species (*latidens*).

RANGE

As now delimited, *Poeciliopsis latidens* is known to occur in streams tributary to the Pacific from the basin of the Rio del Fuerte, along and near the boundaries of Sonora, Sinaloa and Chihuahua, southward to the Rio Quelite (north of Mazatlan) and, along the coast, to the bay at Mazatlan, Sinaloa—all in northwestern Mexico.³ The northernmost locality from which we have seen specimens is a tributary of the Rio

³ See footnote on page 3.

TABLE I. COMPARISON BETWEEN TWO SPECIES OF *Poeciliopsis* FROM MEXICO
Data for *P. latidens* based on many specimens from throughout its known range

Character	<i>P. fasciata</i>	<i>P. latidens</i>
Vertical bars	Fewer, narrower, less variable in number, none replaced by spots.	More numerous, broader, very variable in number, some or all nearly replaced by spots (occasionally obsolescent).
Lateral markings: In mature males	2 to 6, typically 3 to 5, bars ¹ , 50 percent or more extending well below midsides. Two or more bars usually meet or nearly meet at midline of back on each side.	5 to 12, usually 7 to 10, bars and spots (or spots alone), the bars rarely extending well below midsides. Usually at least one, occasionally two, bars meet at midline of back in well-barred populations.
In adult females	3 to 6, usually 4 or 5, bars ² . At least one and usually two or more bars meet at mid-dorsal line on each side.	7 to 14, usually 8 to 12, bars and spots (or spots alone). Typically, one bar reaches to or nearly to mid-dorsal line on one side (in well-barred forms).
Front of dorsal fin	Typically with a jet-black streak on first two dorsal rays and inter-radial membranes; concentrated at base of fin as a black spot.	First ray and inter-radial membrane with a dark streak, not concentrated to form a spot; streak often very weak and pigment nearly absent on membrane in some populations. ³
Front of anal fin: In mature males	Blackened at base of gonopodium; outer parts of rays 3 and 5 not notably darkened.	No black spot at base of gonopodium; outer parts of rays 3 and 5 conspicuously dusky.
In adult females	Typically with a black spot or dash.	A dark streak weakly developed or absent. ³

¹ Based on 58 male subtypes (UMMZ No. 161517).

² Based on 23 female paratypes (CNHM No. 4716).

³ Occasional individuals in some populations approach *fasciata* in this character.

del Fuerte 7 miles northeast of Alamos, Sonora (UMMZ No. 161554). About 25 collections of this species are deposited in the Museum of Zoology, University of Michigan, and others at the University of California (Los Angeles) have been studied.

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EXPLANATION OF THE PLATE

PLATE I

- FIG. 1. Adult males of two species of *Poeciliopsis*. Above: *P. latidens*, 21.2 mm standard length, from Rio Yecorato, Sinaloa, Mexico (UMMZ 164642). Below: *P. fasciata*, 22.2 mm long, from Rio Tehuantepec, Oaxaca, Mexico (UMMZ 161517).
- FIG. 2. Adult females of two species of *Poeciliopsis*. Above: *P. latidens*, 28.5 mm long, same data as Fig. 1. Below: *P. fasciata*, 28.0 mm long, same data as Fig. 1.